MECHANICS AND CONTROL OF ROBOTIC MANIPULATORS

PROF. SANTHAKUMAR MOHAN
Department of Mechanical Engineering
IIT Palakkad

INTENDED AUDIENCE : Undergraduate/graduate students interested in robotics and manipulators

INDUSTRIES APPLICABLE TO : Most of the robotic and service oriented industries will recognize and give a value to this course

COURSE OUTLINE :

Learn algorithmic approaches, mathematical models, and computational and motion control methods applicable to robotic manipulator systems; Recognize and analyze the basic mechanical and electrical systems concerning robots; Analyze and design the basic robotic systems; Implement and investigate the performance of various control techniques to the robotic manipulators

ABOUT INSTRUCTOR :

Prof. Santhakumar Mohan is an Associate professor in the department of Mechanical Engineering, Indian Institute of Technology Palakkad. He has more than 10 years of professional experience in teaching and research. He has been teaching the course on Wheeled mobile robots (shortly mobile robotics) for the last 7 years for both undergraduate and postgraduate students. He is active in the design and development of mobile robots for field applications and has 4 patents filed in India. For more details please visit the webpage(https://iitpkd.ac.in/people/santhakumar).

COURSE PLAN :

Week 1: Introduction: Effector: locomotion, and manipulation. Serial and parallel manipulators. Descriptions, Transformations and homogeneous transformation matrix.

Week 2: Manipulator (serial manipulator) kinematics: Kinematic parameters, different notations, Denavit-Hartenberg (DH) representation, arm matrix. Forward and inverse kinematics. Analytical and numerical solutions. Examples

Week 3: Differential kinematics: Differential (velocity) kinematics, velocity propagation, forward differential kinematics and inverse differential kinematics.

Week 4: Jacobian matrix and Manipulator statics: Mapping between configuration-space to operational-space. Jacobian matrix and Pseudo inverse concepts.Introduction to workspace singularities.Manipulator statics: Conservation of energy or power, the mapping between operation-space to configuration-space inputs examples

Week 5: Manipulator dynamics: Motion dynamics: Forward and inverse dynamics. Lagrangian (Lagrange-Euler) and Newton-Euler formulations. Examples

Week 6: Dynamic simulation: Dynamic modeling of robotic manipulators and computer-based numerical simulations.

Week 7: Trajectory generation: Path and Trajectory. Configuration (joint) space trajectory and operational (task) space trajectory generations.

Week 8: Control of robotic manipulators: Joint space and task-space control schemes.